In-Place Pavement Recycling - Moving Towards a Sustainable Future

First Western States Regional
In-Place Recycling Conference
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Outline

- Ontario road system overview
- Past - What have we learned
- Present - Current practices and improvements
- Sustainable Future - Challenges

Ontario Road System

- Provincial System
  - Funded through provincial taxes
  - 16,520 centre-line km, 3000 bridges
  - $ 1.7 B Capital Constr.
- Municipal System:
  - 152,000 centre-line km 132,000 bridges

MTO Pavement Network Composition

- Provincial Road Network
  - freeway 8,900 lane-km
  - arterial 13,000 lane-km
  - collector 9,800 lane-km
  - local 7,500 lane-km
- 95% ==> Bituminous pavements
- 5% ==> Concrete and other types of pavements
- 70% of Canada's exports and $1.2 trillion in goods are carried on Ontario's provincial highways

Hwy 17, Northern Ontario

Hwy 401, Toronto

Greening Pavement Initiatives

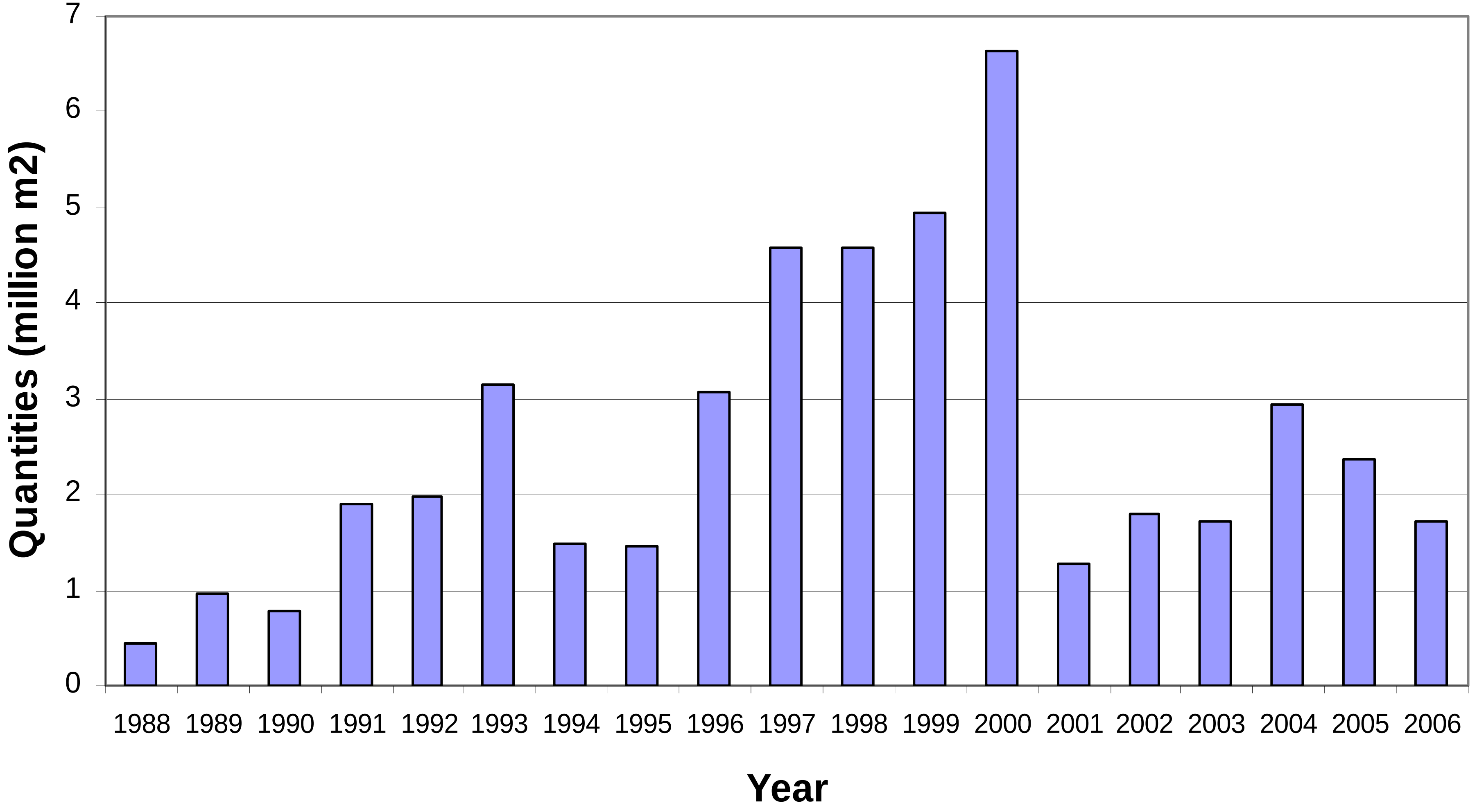
Environmentally friendly pavement design, preservation and rehabilitation strategies include:

- Reuse and recycling of materials
  - Pavement recycling
  - Roof shingles, rubber tires, glass and ceramics
  - Blast furnace slag, fly ash and silica fume
- Warm mix asphalt concrete
- Drainable/permeable pavements
- Reduced noise and perpetual pavements

Implementation of Pavement Recycling in Ontario

- Central plant recycling - late 70's
- Milling, partial depth - early 80's
- Full depth reclamation - mid 80's
- Cold in-place recycling - 1989
- Hot in-place recycling - 1990
- FDR with EA (FA) - 2000
- CIR with EA (FA) - 2003

MTO In-Situ Asphalt Recycling Quantities



Full Depth Reclamation - FDR

Hot In-Place Recycling - HIR

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FDR with Expanded Asphalt Stabilization

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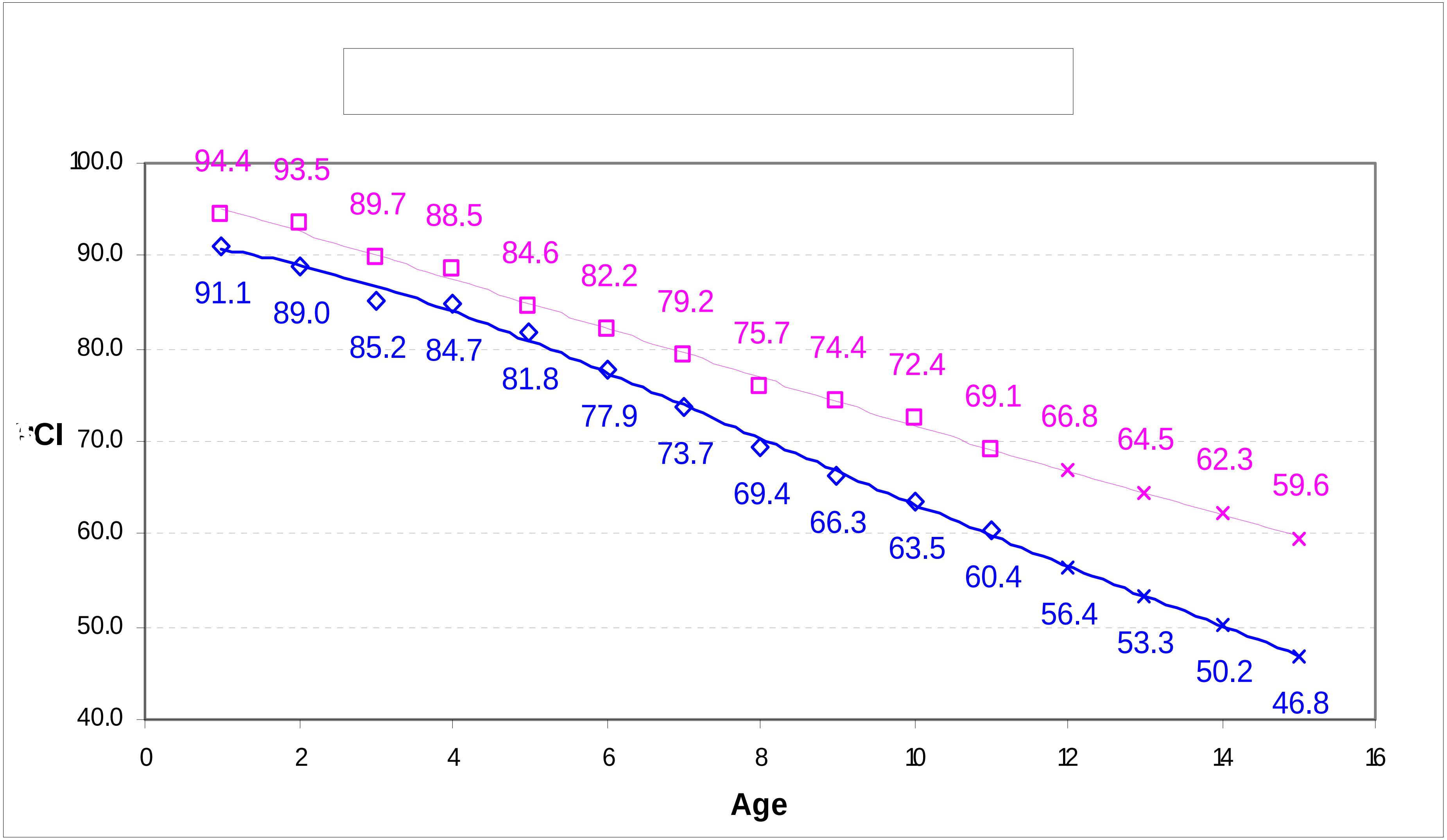
CIR with Expanded Asphalt

Summary of Quantities

• Full Depth Reclamation (FDR)	30,924,196 m^2
• Hot In-place Recycling (HIR)	1,009,607 m^2
• Cold In-place Recycling (CIR)	3,086,715 m^2
• FDR with Expanded Asphalt	1,712,655 m^2
• CIR with Expanded Asphalt	339,179 m^2
• Total Since 1995:	37,072,352 m^2

Past Performance

- In-situ recycled pavements have performed well, often carrying significantly more traffic over their service life than anticipated.
- Designs built in the past have evolved from theory, road tests, and trial and error.
- Lessons have been learned from design problems/flaws, materials, and construction practices that have caused problems.



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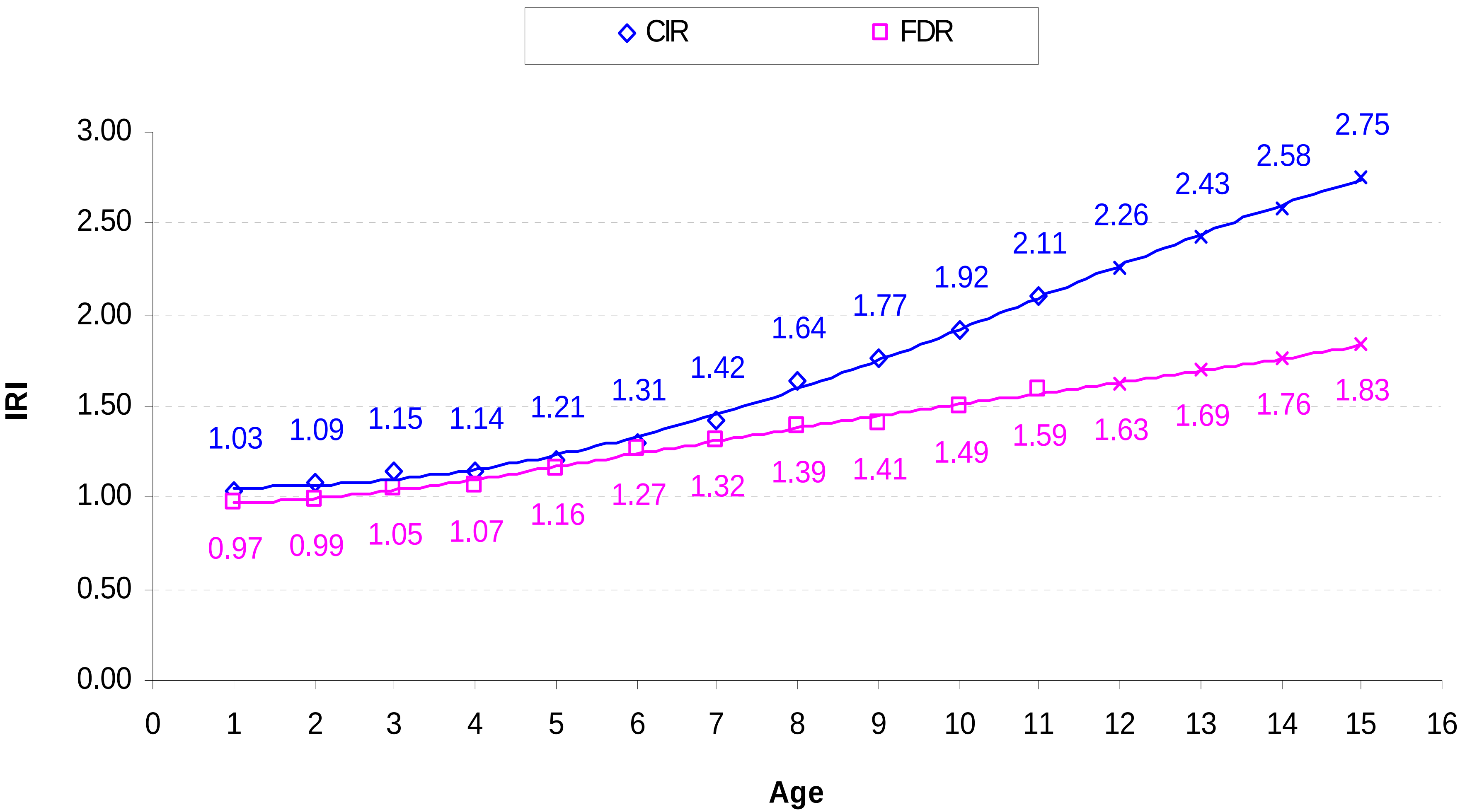
IRI Comparison - CIR vs FDR



Current Practice

Recent improvements in **design**, **materials** and **construction** processes have significantly increased the benefits of in-situ recycling techniques.

Improvements in technology have provided cost effective designs and optimization of rehabilitation strategies.

Design Improvements

Pre-project Evaluation

- Pavement and subgrade condition & variability
- Review PMS records
- Adequate field testing

Design Improvements (cont.)

Pavement Investigation and Structural Design

- Detailed pavement condition survey – PCI & FWD
- Adequate asphalt, granular, & additive testing
- Mix design methods, “Cold Marshall” method
- Structural equivalency factors developed (GBE or a_1)
- Mechanistic-empirical design methodology
- Performance databases - PMS and AMS principles
- Economic assessment - Life Cycle Costing Analysis

Design Improvements (cont.)

Comprehensive Construction and Material Specifications

- OPSS 330, Full depth reclamation
- OPSS 334, Cold recycled mix
- OPSS 333, Cold in-place recycling
- OPSS 332, Hot in-place recycling
- OPSS 331, FDR with Expanded Asphalt Stabilization
- OPSS 335, CIR with Expanded Asphalt (pub.Nov/05)

Available online:

http://www.mto.gov.on.ca/english/transrd

Design Improvements (cont.)

Post Project Evaluation

- Review QC results/material quantities
- Assess performance – surveys, coring, NDT, lab testing
- Revise design procedures/parameters

Material Improvements

- Evolution of in-situ recycling products
  - Improved emulsions
  - CIR and FDR with expanded asphalt
  - Lime and cement slurry stabilization
  - Combination of additives
- Material and lab testing technology
- Benchmarking of material properties
- Improved surface courses – SuperPave Mixes
- QC and QA testing methods

Construction Improvements

- New in-place recycling equipment and processes
- Numerous qualified & innovative contractors
- Move from method specifications to ERS to performance related specifications
- Quality control and quality assurance methods
- Superior evaluation processes
  - FWD, GPR, M_R testing, etc.

Towards a Sustainable Future

What is Sustainable Development?

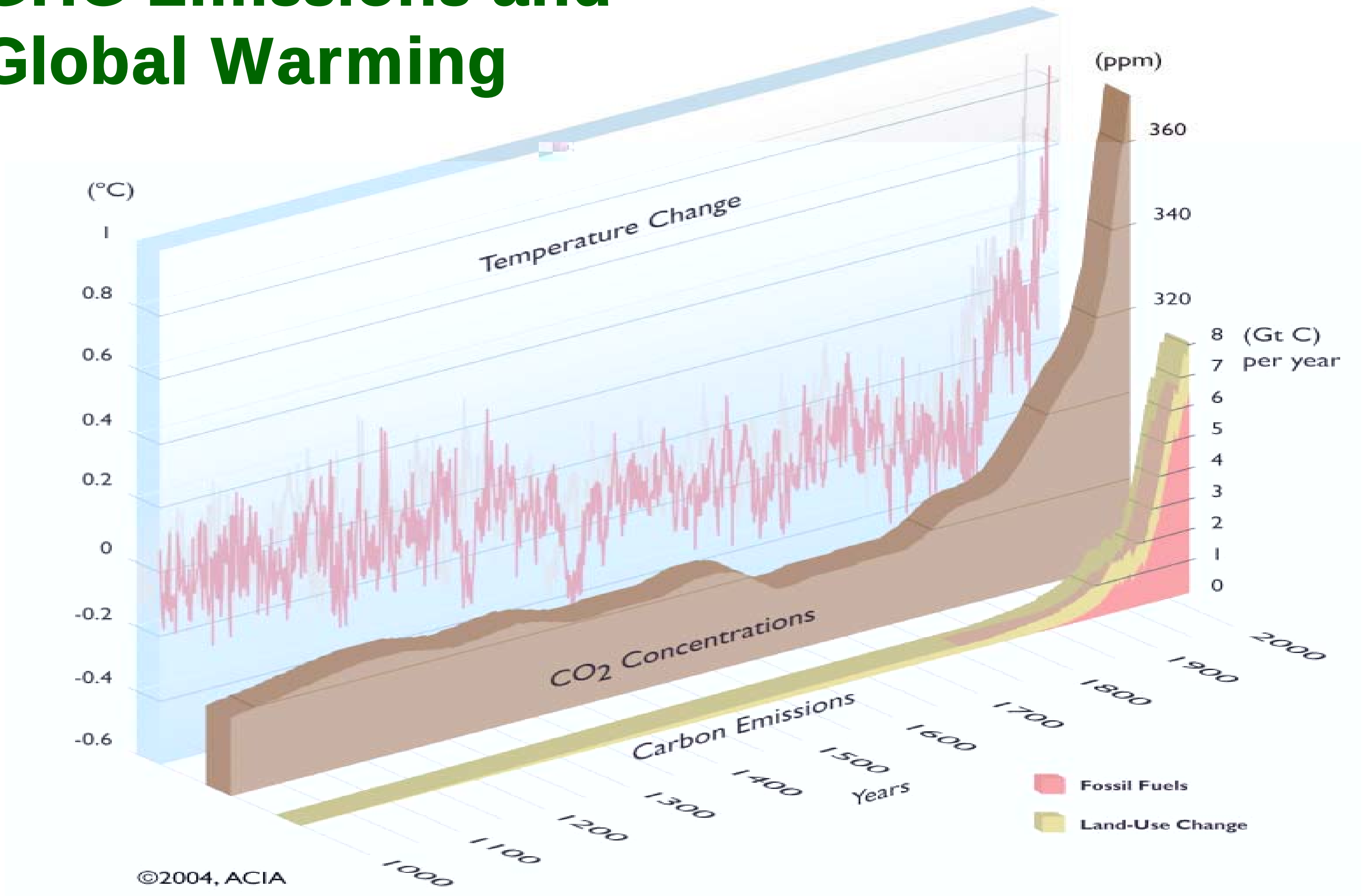
"…. Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Towards a Sustainable Future

To achieve sustainability, every corporate decision should consider the impact of the triple-bottom-line.

"What are the Social, Economic, and Environmental (SEE) Impacts of the decision"

GHG Emissions and Global Warming



Variation in Mean Surface Temp and CO_2 Concentration

Kyoto Protocol

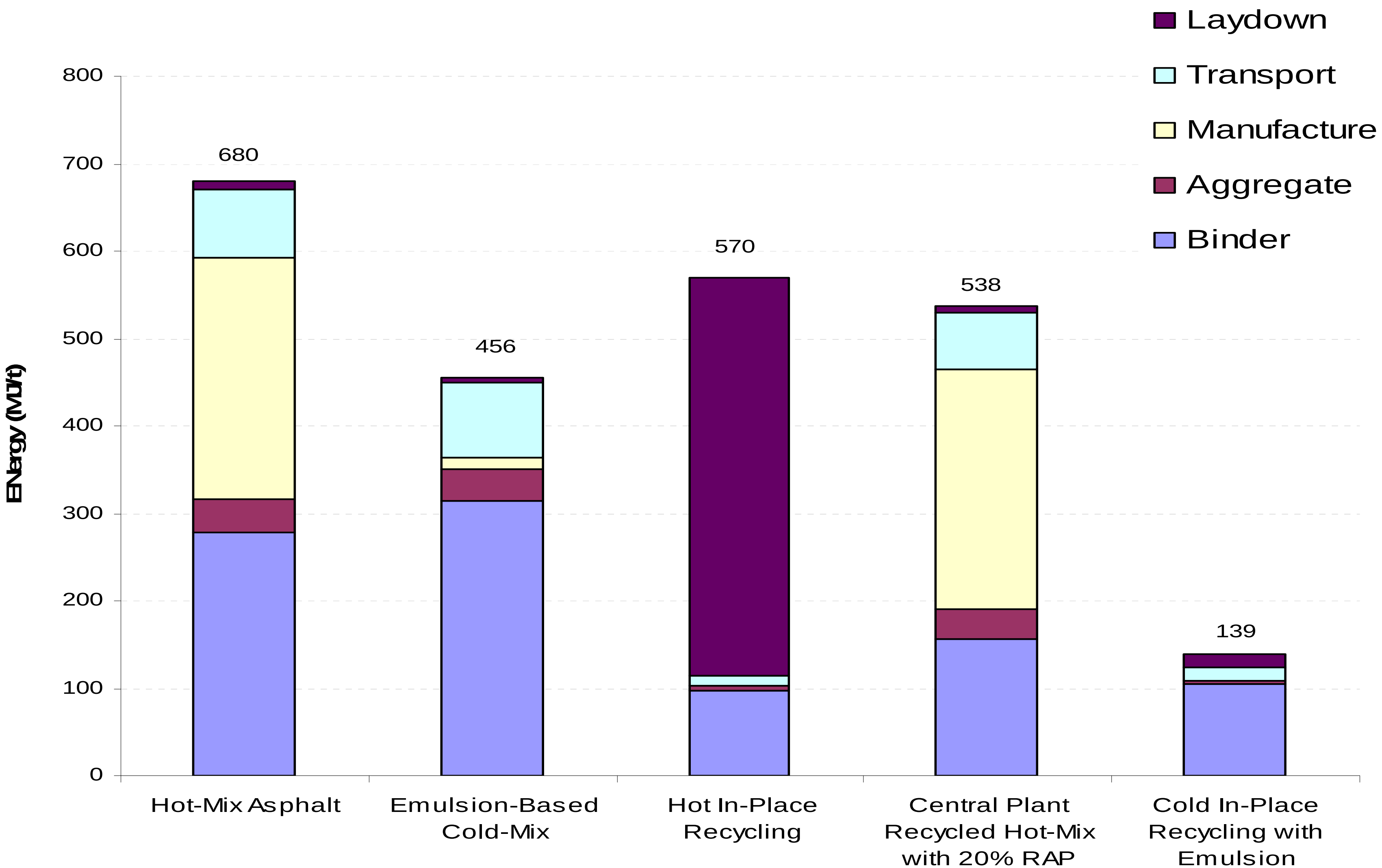
- Adopted in 1997 to address global warming by reducing greenhouse gas (GHG) emissions
- Came into effect on Feb 16, 2005 with 141 countries signing on
- In-situ recycling technology and construction practices are well positioned to assist in achieving this challenging goal

Sustainable Pavement Criteria

" ….safe, efficient, environmentally friendly pavements meeting the needs of present-day users without compromising those of future generations"

- In-situ recycling technologies address the main criteria for a sustainable pavement:
  - Optimizing the use of natural resources
  - Reducing energy consumption
  - Reducing greenhouse gas emissions
  - Limiting pollution
  - Improving health, safety and risk prevention
  - Ensuring a high level of user comfort and safety

Energy Use Per Tonne Of Material Laid Down



Source: *The Environmental Road of the Future, Life Cycle Analysis* by Chappat, M. and Julian Bilal. Colas Group, 2003, p.34

Sustainable Pavements

- The report concludes that recycling technologies are the most promising tool to assist in the selection of environmentally friendly flexible pavements.
- MTO's primary pavement design/rehabilitation goal is to provide safe durable roads that maximize the use of recycled materials.

Ontario Case Study

Environmental Benefits of
In-place Recycling (CIR + CIREAM)
vs.
Mill and Overlay

Impact Evaluation

- PaLATE software -

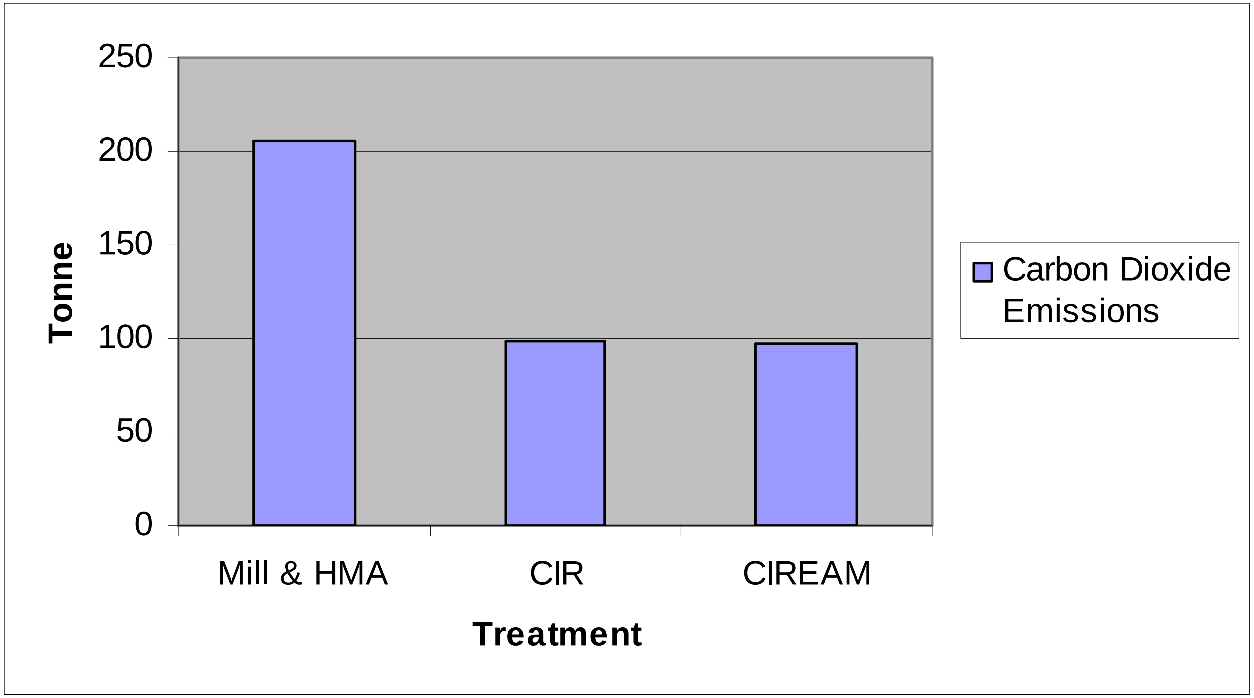
  Pavement Life-cycle Assessment for Environmental and Economic Effect
- Created by Dr. Horvath of the University of California at Berkley
- Assists decision-makers in evaluating the use of recycled materials in highway construction (both LCC and Environmental Impacts).

Study Assumptions

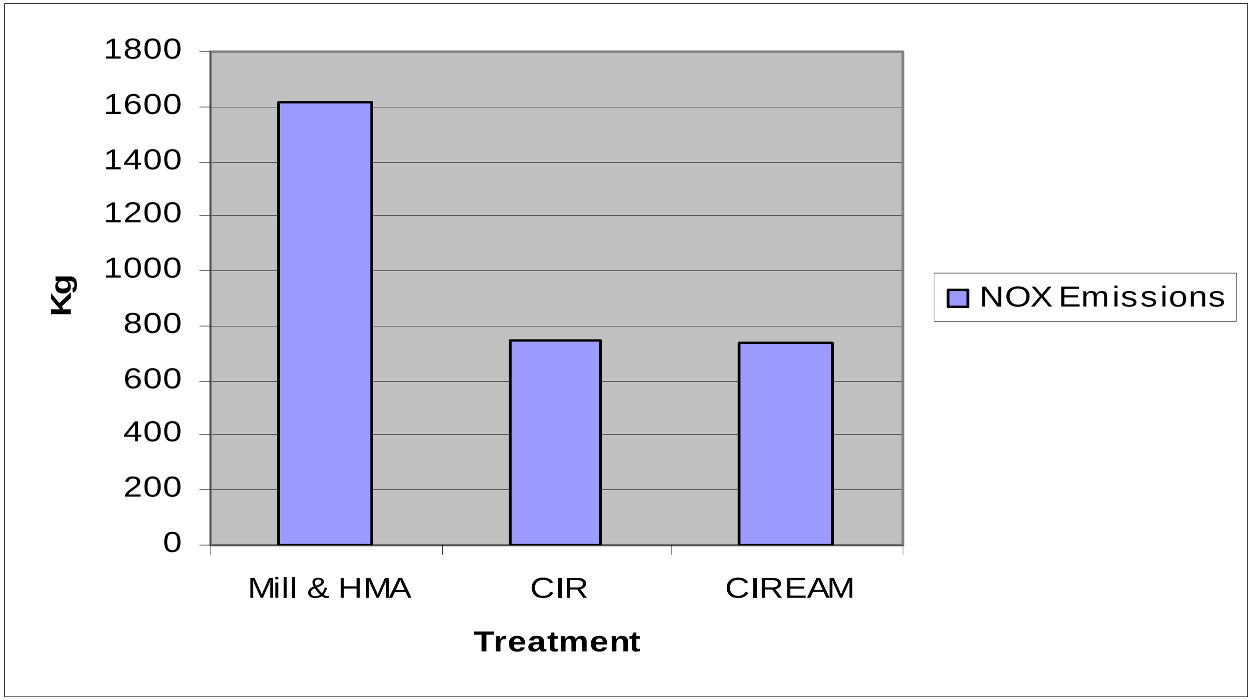
	CIR	CIREAM	M&O
Existing HMA Depth	150mm	150mm	150mm
New HMA	50mm	50mm	130mm
% AC	5%	1.0% & 5%	5%
% Emulsion	1.2%	0	0

Using PaLATE model, the following emissions were calculated and compared:

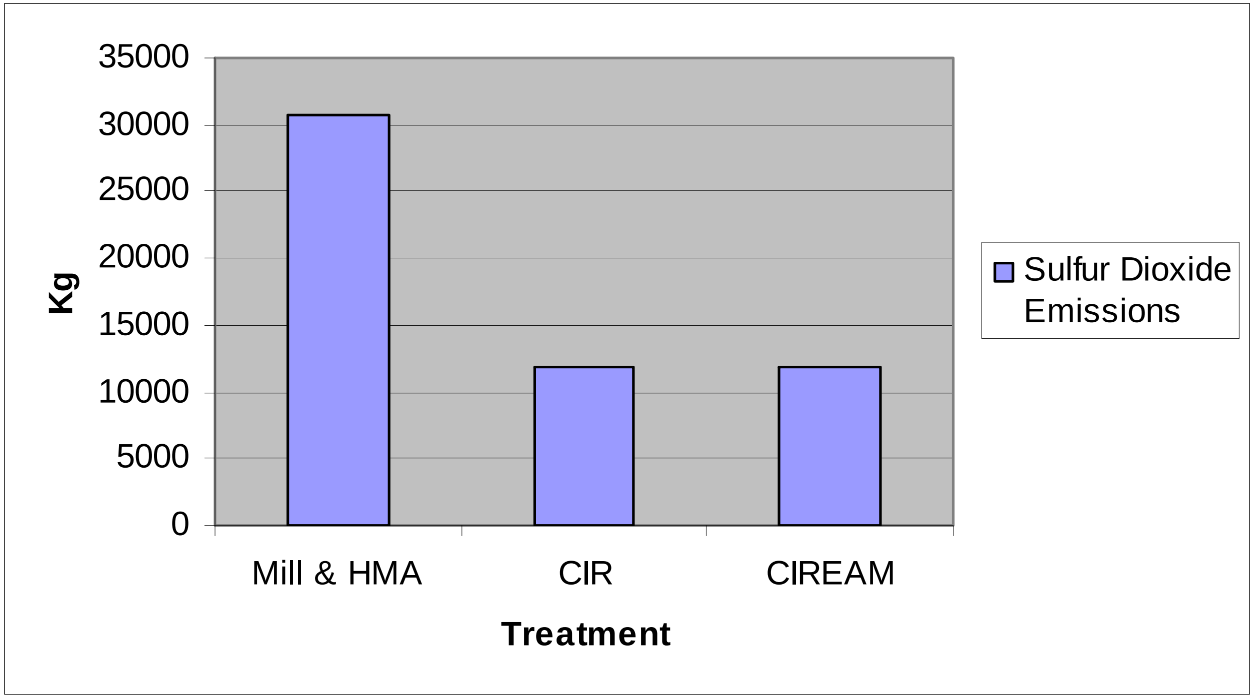
CO_2 Emissions



NO_X Emissions



SO_2 Emissions



Environmental Benefits

- Per 2-lane km, CIR/CIREAM emits approximately 50% less GHG, consumes 62% less aggregates, and costs 40-50% less when compared to a conventional mill and overlay treatments
- Since the implementation of CIR/CIREAM contracts, MTO has reduced GHG emissions by:
    - 54,000 **t** of CO_2
    - 440 **t** of NO_x
    - 9,400 **t** of SO_2

And saved 740,000 tonnes of aggregates

Technology Transfer

- CIR/CIREAM are two of the most environmental friendly flexible pavement rehabilitation techniques available; they reduce Life Cycle Costs, reuse existing non-renewable material, minimize new materials and reduce on site transportation.

- MTO actively promotes CIR/CIREAM through technical papers, presentations and by example

Sustainable Pavements in Ontario

- MTO currently uses numerous innovative in-situ recycling technologies that conserve aggregates, reduce GHG emissions, and minimize energy consumption
- A key MTO sustainability strategy is to implement these technologies on a larger scale and encourage their use province wide.
- These technologies support a “zero waste” approach and will assist in meeting our emission reduction commitments while addressing the triple-bottom-line (SEE).

What's next?

- Current Life Cycle Costing (LCC) includes:
  - Initial, and discounted main/rehab costs and remaining life costs
  - User costs
- We now have the tools to calculate GHG emissions and energy savings – PaLATE software
- Moving towards including an environmental component into LCC (Environmental benefits/credits).
- Insures that the best treatment is selected to benefit economic, social and environmental needs

  - a Sustainable Approach.

Summary

MTO will better achieve its sustainable pavement goals through:

- Building on current industry/ministry partnerships in the development of improved in-situ recycling specifications and design/construction procedures
- Encouraging continued innovation by the province's in-situ recycling contractors
- Supporting dedicated research programs to advance the technology
- Increasing technology transfer to accelerate adoption of in-situ recycling concepts

Conclusions

- There is an increased focus on sustainable asset preservation in Ontario, both at the provincial and municipal levels
- Pavement preservation and rehabilitation incorporating timely insitu recycling treatments can significantly extend pavement life and result in improved network performance over time
- Implementation of **sustainable** AM principles and performance measures are critical to addressing infrastructure investment requirements and **environmental stewardship** over the long-term

Thank you!

Questions?

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